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ABSTRACT

Rural schools face significant challenges in upgrading their technology infrastructures. Rural school districts tend to have older school buildings that have multiple problems and lack climate control, adequate space, and necessary wiring. In rural districts, it may be difficult to find the leadership and expertise needed to provide professional development, create an appropriate technology plan, and manage and maintain building and system infrastructures. In addition, rural districts may not have local companies available or willing to partner with schools in technology projects, and staff members may not have the time or experience to write grant applications for technology development. Wayne (Nebraska) Community School District overcame these difficulties through a collaboration with Wayne State College, the chamber of commerce and city council, local businesses, federal and state agencies, and the students themselves. In 1992, a districtwide committee of diverse stakeholders developed goals and identified needs for a comprehensive technology plan. During the plan's implementation, the nearby college was a constant resource. Stages in the plan included installation of a computer lab, distance education activities, expansion of technology infrastructure with a corporate grant, and development of a communitywide computer network. Lessons learned from the Wayne experience concern the needs for careful planning, continual training of staff and students, and a vision for the future. (SV)

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CHAPTER 4

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Creating Technology Infrastructures in a Rural School District: A Partnership Approach

DENNIS JENSEN

A 1995 General Accounting Office report on school facilities suggested thinking about a school's technology infrastructure as having two parts. First there is the *building infrastructure*, which includes physical aspects such as the conduits through which computer networking cables are laid in the school, the cables and wires themselves, and the electrical power lines and outlets. Second, there is the *system infrastructure*, which includes software and hardware elements such as networking software, modems, computers, and printers.[1]

The first part of this chapter reviews student access to computers and the Internet, and issues related to both building and system infrastructures in rural schools. It also focuses on staffing resources, or the "human infrastructure," without which it would be difficult to upgrade buildings and systems. The second part of the chapter features a case study of a technology program in Wayne, Nebraska. This small rural town, with help from grant monies, local college personnel, and enthusiastic community members, was able to put together an impressive technology program for its school district.

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Student Access to Computer Technology and the Internet

Recent data from the National Center for Education Statistics (NCES) suggest that things are changing rapidly in the field of educational technology. NCES reported that 95 percent of all schools are now hooked up to the Internet, and that access to the Internet appears to be equal across all schools regardless of where they are located (rural or urban). In 1999, 63 percent of public school instructional rooms were connected to the Internet. This number is expected to increase due to the allocation of funds from the federal Education-rate (E-rate) program, which provides discounts on connectivity for high poverty and remote schools. The ratio of students to computers in public schools is about six to one nationwide, although the ratio of students to computers with Internet access is slightly higher (about nine to one).[2]

Access to the Internet still varies by school poverty level, with high poverty schools less likely to have a low ratio of students to Internet-connected computers.[3] While many schools still use dial-up network connections to access the Internet, a growing proportion of schools uses higher speed dedicated-line connections. By 1999, 49 percent of the nation's public schools connected to the Internet with a T1 line, 23 percent used an individual or network modem, 7 percent used a cable modem, 7 percent used ISDN, and 12 percent used a 56kb line.[4]

Challenges Faced by Rural Schools

Rural schools that are still in the process of upgrading their technology infrastructures face significant challenges in retrofitting their buildings. Although elements such as wiring, electrical outlets, and conduits are easy to install when constructing a new building, installing them in existing school buildings can be expensive and disruptive.[5] Rural school districts often have older school buildings with multiple problems and lack climate control, appropriate space for computer labs, and necessary wiring. Further, schools with such basic concerns as leaking roofs or wiring problems find it difficult to invest in technology upgrades.[6] Schools without air conditioning have difficulty maintaining computer rooms at a temperature that keeps computers from overheating. Finally, some schools simply lack the space needed to develop state-of-the-art technology programs.

System infrastructure can sometimes be even more expensive than building infrastructure, but an up-to-date system can be extremely valuable. Networks and Internet access can link even the poorest, most isolated school districts to powerful educational resources such as libraries and "virtual field trips." They can also link teachers to other teachers and to professional development resources such as course materials and lesson plans.

In rural school districts, it can be difficult to find the leadership and expertise needed to provide professional development, create an appropriate technology plan, and manage and maintain building and system infrastructure.

Two recent reports on the use of technology in schools highlight the importance of professional development and training for effective staff and student use of technology in schools.[8] Knowledgeable and enthusiastic technology staff play key roles in planning, designing, implementing, using, and maintaining computers and other associated technologies. Yet, because of their remote location and small size, rural communities are less likely to have local businesses or community members with technology expertise, and tend to have less success attracting such individuals to the community. It is often impractical to contract out the work due to a lack of local businesses that offer computer services.

One solution to this problem is to identify a staff or community member who, with training, will serve as the "home grown" technology coordinator. Within small rural schools, there is usually a willing faculty member with an interest in computers who can serve as a part-time network coordinator. Expectations for this individual must be realistic, however, and he or she must be given enough time and support to develop expertise.

Besides understanding computer hardware and software systems, the technology coordinator must also be skilled at training and encouraging teachers who may be resistant to adopting technology in their classrooms and administrators who completed their educational administration programs before the current emphasis on computer technologies. Without assistance, administrators with no early hands-on experience and little interest in technology may continue to de-emphasize technology and provide little direction for future applications. In urban areas, administrators have more networking or training

opportunities that allow them to learn about technology issues. However in rural districts, there may be only one or two administrators, greatly decreasing the likelihood of an administrator having technology experience.

A popular strategy used in urban areas for successfully building school technology infrastructure and expertise is partnering with local businesses. Rural schools, however, face obstacles to such partnering arrangements because few or no local companies are available to partner with or proposed partnerships do not offer enough return to the company. While there are national and international firms willing to offer software, hardware, or money for specific projects, they generally want a high return on their investment, which can most easily be shown by serving high population areas. Rural districts find it difficult to compete with urban schools in this arena because of low enrollments.

Rural schools face other common obstacles, as well. In competing for grant dollars, rural schools tend to be at a disadvantage because each staff member, from administration to faculty, is usually wearing two or three hats (duty assignments) and does not have the time or experience to write a successful grant application. Grant funding can also have a hidden downside. Frequently schools receive funds to purchase equipment but not to upgrade it. In poor, rural districts, it may be difficult to find funding for technology management and maintenance after the equipment has been purchased. Yet, none of these challenges are insurmountable, as demonstrated in Wayne, Nebraska.

Technology Integration in Wayne, Nebraska: One School's Experience

Traditional paradigms no longer dominate education in Wayne, Nebraska, a small town in the American heartland. Through an unusual collaboration, the scope of Wayne Community School District's curriculum now includes the world. The collaboration has included Wayne State College, Wayne Community Schools, Wayne Chamber of Commerce, Wayne City Council, the mayor of Wayne City, private businesses, federal and state agencies, and, especially important, the students themselves.[9]

The payoff for this collaboration has been a powerful technological infrastructure that has enabled the district to offer e-mail, audio/video on-line capabilities, take-home computers, public library access to the Internet, staff training on curriculum and technology integration, automated libraries, central office telecommuting, tech-prep curricula, and much more. The most impressive aspect of the Wayne community project, however, is its time span. In just three years, a rural school district in a town of 5,000 people was able to develop a multifaceted technology service with over 450 networked workstations for 950 students. The project began in 1992 with just $50,000 and 26 Apple IIs.

How It Began

The motivation for the district to become a regional leader in technology originated with its school board. At a regular meeting in the fall of 1991, a state review panel reported a lack of hardware and software use throughout the district. The panel recommended serious attention be directed at creating opportunities for students to learn about technology. In 1992, the superintendent organized a districtwide technology committee. The committee's goals were to set a technology vision for the district, establish goals in curriculum scope and sequence, evaluate software and hardware needs in every field and student service area, and develop a timetable with which to measure progress. Committee members included representatives from private business, Wayne Chamber of Commerce, Wayne State College, the Nebraska Department of Education, and the local school district.

Committee members met throughout the summer, and in the fall of 1992 proposed a comprehensive program to the board of education. Among the recommendations were

- a 3:1 ratio of students to computers
- a K-12 computer curriculum (separate from other fields)
- a restructured industrial arts curriculum to include industrial technology
- automation of the district's three libraries
- distance education development
- a networked computer lab
- a hardware purchasing plan focused on IBM-compatible workstations

After the recommendations were approved by the board of directors, the district was off and running. The board earmarked $50,000 in 1992 for initial costs. Combined with general fund dollars (the total district budget in 1992 was just over $4 million), the board's investment grew to $75,000, and plans were drawn for a 25-station computer lab in the high school to replace the typing room. During the bidding process to build the lab, Dennis Linster, director of Network Services with Wayne State College, asked the superintendent to delay bid openings until he could arrange for a summer session class for graduate students titled "The Wayne High Computer Lab." The course's objectives were to design, implement, and install the high school's computer lab. The initial involvement opened the doors to an unparalleled relationship between the school district and college that continues today.

By August 1993, the district had 25 networked computers installed in a new computer lab, with a central server connected via a 16-megabyte Token Ring network located in the high school's library. The cost savings enjoyed by the district were phenomenal because graduate students completed the physical labor. Estimates in savings ranged from $12,000 to $25,000. Participating graduate students benefitted from the experience and transferred the knowledge back to their own districts. Although the computer lab represented a monumental step for the district, it was only the beginning of a collaborative program that continued to blossom.

As the computer lab neared completion, the board of education wrestled with a new school budget. From the funds not spent the previous year, they transferred $101,000 into a new technology fund. The district retained its focus on the technology plan adopted in 1992 and began the following projects:

- automating the middle and high school libraries
- building a technology lab in the industrial arts area of the middle school
- fully computerizing the central office and bookkeeping system
- expanding the computer network in the high school and adding computers
- adding a CD-ROM tower to the network

- providing training for staff on the computer network, and on Internet-access instruction
- automating a lunch ticket accounting system
- implementing a distance education system in the middle and high schools with donations from Wayne State College and private businesses in Wayne

As the system grew, the college was a constant resource for project development and design. Because the size of the system was taxing available volunteer time, the district decided to hire a part-time technology director. Mike Eckhoff, a 1993 Wayne High graduate and a talented college student majoring in computer systems, became the primary supervisor of the technology implementation plan. A high school senior, Trevor Schroeder, became Eckhoff's assistant. While Eckhoff was hired on a part-time basis, Schroeder volunteered his time in order to gain firsthand experience in network operations.

Distance Education Activities

A distance education project was started in the fall of 1993 with financial support from Wayne businesses and the Wayne State College Foundation. The project's goal was to improve the high school Spanish III course by having a two-way audio/video link in real time with a school in Juarez, Mexico. The distance education mode chosen was a simple telephone line connected to a computer, a video camera, and a speaker, which allowed an interactive course to be team-taught between two sites. Faculty training was provided by TSN, Inc., in Boiling Springs, Pennsylvania, and by the Pennsylvania Department of Education at both Wayne State College and Wayne High School. Teachers from Wayne High were furnished with training, as were teachers from Juarez and Cancun, Mexico. The distance education failed due to problems in Mexico, but a second undertaking was started in the middle school with grades 6-8, using videophones connected to schools in Japan.

In March 1994, a third distance education activity began with funding from the National Science Foundation and the leadership of the Nebraska Department of Education, Division of Technology. With the guidance and assistance of director Melodee Landis, the recently released Windows version of CU-SeeMe software (developed by

Cornell University) was tested as a beta project in Nebraska between Wayne and Omaha North High Schools. The project had technical problems initially, but in further tests, the DOS version of CU-SeeMe worked well for site-to-site distance education applications.

The benefit Wayne schools reaped from the distance education project grants was procurement of the hardware and software allowing simultaneous access to the Internet from all networked computers. The district remains actively involved in pursuing distance education projects, especially those using the Internet as the connecting link. Spanish instruction continues to be provided through a satellite downlink for grades K-3. The district has benefitted most recently from a Department of Commerce grant to establish an "Anytime, Anywhere, Anyplace" distance delivery system with archived video and audio components.

A "Lighthouse" District Shines

In the summer of 1994, the Wayne County School District was chosen to receive a $91,000 award from U.S. West. This regional telephone company sought school districts committed to technology for the purpose of developing "lighthouses" to serve as models throughout the state of Nebraska. The award helped advance the 1992 technology plan and, with various installations, enabled the district to

- increase the number of K-8 workstations
- connect both middle and elementary schools to the Wayne campus with Ethernet and Token Ring networks
- create a map of the network to plan for possible future Web applications
- purchase 20 laptop computers for fourth graders to take home and use for assignments

The board of education also earmarked $60,000 in the summer of 1994 for computer technology needs in K-12. Additionally, the board had the foresight to permit the high school industrial arts department to convert to a tech-prep lab. What sparked the board's interest in restructuring the industrial arts curriculum was the 1991 state department review (mentioned earlier). The report indicated only eight percent of students participated in the industrial arts program, while 28 percent of the high school's total facility space, as well as two full-

time instructors, were devoted to it. As a result of the newly implemented tech-prep program and the positive influences of factors such as faculty support of curriculum change, the 1995 student participation in the industrial arts program grew to about 37 percent.

In the fall of 1994, several other projects were undertaken, including linking the buildings on the Wayne campuses with fiber optic cable and Novell server software, automating the middle school library, and linking 250 workstations from three different buildings in Wayne to servers located in the high school library. A staff development program was instituted by the school principals that allowed staff training in technology applications during the school day. A networked computer was installed in the teachers' professional library in the high school, a gift from Complete Computers, a local business in Wayne. A battery back-up system and network support technology were provided through a gift from Wayne State College. An audio/visual laboratory was established for students to develop commercial-quality video productions such as animated cartoons. This laboratory included digitizing video equipment, morphing capabilities, and video and audio editing equipment that are all networked to the central Novell file server in the art department.

WayNET Adds Links to Community

The Chamber of Commerce and the city became curious about the Internet. How could access to it provide benefits for rural economic development and community growth? The chamber established a strategic planning committee to study providing access to the city. Over an 18-month period, committee members administered a community survey on computer use at home, held several informational meetings at various sites, and sponsored speakers who spoke about other communities' Internet experiences. Finally, they submitted a telecommunications grant application to the state Department of Rural and Economic Development and received $2,500.

These grant dollars were used to begin developing a new community service, WayNET. Its purpose was to offer Internet opportunities to all citizens of Wayne. WayNET was administered by a committee composed of the mayor, the city administrator, the network services director from Wayne State College, the Educational Service Unit technology director, the technology director from Wayne Community

Schools, and the school superintendent. In September 1995, the city council directed $14,000 to the WayNET project, expanding the telecommunication services of the school district. With 16 remote-access lines connected to a T1 line within the Nebraska frame-relay system, patrons living in Wayne can use the Internet at their leisure. Using the computer lab in the high school, the school district's technology team trains all interested community members on how to access the remote system. This remote-access course is offered through an adult education class, a function of the extension service of Northeast Community College in Norfolk, Nebraska. Instruction is provided by Wayne State College and Wayne High School students, who are paid for their services by Northeast Community College. Participants in adult education classes are given access to the high school's remote telecommunications system for an indefinite period of time for only the cost of class registration.

The district operates an elementary school in Carroll, Nebraska (14 miles from the central server), where it is in the process of installing eight remote lines for K-4 elementary Internet access. This will bring the total number of community access lines to 24. This Internet access is a collaborative effort involving a state college, community college, state agency, city council, local chamber of commerce, special education service agency, city administration, college and high school students, and a local school district. These groups are working together efficiently to provide a service to the public that would be difficult to replicate at such a reduced cost by any one member alone.

Lessons Learned from the Wayne Experience

The community of Wayne has been extremely fortunate. It has had the right people in the right places at the right time as it developed technological services for its children and the broader community. A critical factor in the success of the overall project was the cooperation of the faculty and staff of the Wayne Community School District. The faculty wanted to encourage as much technology integration as money would allow, and they were eager to share their knowledge. The district also benefitted from using local college students and consulting with college administration on implementation issues.

The rural schools in Wayne succeeded in integrating technology into their curricula, but it took the united effort of almost every agency

in the community. In addition, other rural districts may find they frequently must seek help from regional and state agencies. Based on the Wayne story, financial support may be available for rural districts if someone in a leadership position is dedicated to seeking funding. Once the funding is secure, then human resources can be sought.

In Wayne's success story, it is important to note that while it was exciting to put it all together, in technology the job is never done. When the 1997 school year began without a new implementation plan and a new network director, network growth began to stagnate. A new technology committee was not formed until January 1998, and the district began experiencing problems trying to maintain such a large network with so little labor support. Older machines also became outdated, and a plan had to be designed to replace and transfer them to lower-use areas. Computers in the industrial technology area had to be replaced, as did the old server.

Wayne's story is probably typical of many places in this regard. A large network presents constant problems that need continual attention. Consequently, technology plans must include provisions for ongoing management, maintenance, and upgrading of equipment. Boards of education, administrators, and teaching staffs must realize and accept that computers and ever-changing technologies are an integral part of school today and may play an even more significant role in K-12 education in the future. The Wayne experience also taught us that while technology can be used to improve subject area teaching and learning, students also need the opportunity to learn a wide range of technology applications and skills. Because teachers are the first point of contact for most students, their skills and understanding of the importance of technology are important to student success.

When districts lack a plan to integrate technology into the classroom and to train teachers in uses of technology, opportunities to improve learning and open educational vistas to the world are inhibited. Additionally, if staff development activities are not consistently focused and aligned with district-wide standards of achievement for teachers and students, then the technology services offered the students will not reach their full potential. Consequently, the district must make a significant financial commitment to train staff to implement technology into the classroom.

Conclusion

Both rural and urban schools suffer from insufficient funding to properly integrate technology into the classroom. They also face strong competition for technology employees from private industry, which can offer higher salaries and better benefits. Still, rural communities and districts share some characteristics that make it especially challenging to adopt and maintain technology applications in their schools. Examples include lack of skilled employees and community business partners, remote locations, and old buildings in need of retrofitting and repair.

However, being more difficult doesn't mean that the problem is insurmountable. Rural school districts need to be risk takers when it comes to technology. Using grants and one-time funding opportunities to get technology programs going and to experiment with multiple types of technology allows rural districts to maximize available resources. This risk taking should be coupled with (a) careful planning, (b) continual training of staff (and sometimes students) to help manage the technology program, and (c) a vision for the future. If a rural district can focus the efforts of many leaders in the community, whether they are farmers, retail dealers, or faculty and staff, great advancements can be made. There is an enormous sense of pride in small communities and, if that pride can be channeled in the right direction, the students will not be lacking in any technical preparation.

In some cases, rural schools may be able to use technology more creatively than their urban counterparts because the bureaucracy is more manageable in smaller rural districts and change can be implemented at a faster pace. Although challenging, the rewards for children from instituting a quality technology service in the school make all the problem-solving worthwhile. Once a complete technology plan is in place, an administrator can feel confident that any graduate, and eventually the community as a whole, will be able to compete in a technical world—and not be at a disadvantage due to being rural.

Notes

1. General Accounting Office, *School Facilities*.

2. National Center for Education Statistics, *Internet Access in U.S. Public Schools*.
3. Fatemi, ed., "Technology Counts '99"; Jerald and Orlofsky, "Raising the Bar on School Technology"; and National Center for Education Statistics, *Internet Access in U.S. Public Schools*.
4. Jerald and Orlofsky, "Raising the Bar on School Technology."
5. General Accounting Office, *School Facilities*.
6. Dewees, *Improving Rural School Facilities*.
7. General Accounting Office, *School Facilities*.
8. General Accounting Office, *School Facilities*, and McNabb, Hawkes, and Rouk, *Critical Issues*.
9. For other articles and chapters by Dennis Jensen describing Wayne, Nebraska's technology program, see "WayNET: A School Internet Service," "Rural District's Partnerships Bear Fruit," and "Case Study on Technology Development."

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